Rhodora

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THE FLORA OF PENIKESE, SEVENTY-FOUR YEARS AFTER

I. PENIKESE ISLAND MARINE ALGAE

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In 1873 and 1874 Penikese Island, one of the southernmost of the Elizabeth Islands, off the southern elbow of Cape Cod, was the site of the first marine biological station in North America. Though it was in operation only two years, the enthusiasm for marine biology engendered by the founder, Louis Agassiz, swelled and endured. It persists today in the sincere aggregation of organizations assembled at Woods Hole, Massachusetts. In commemoration of that initial effort, a fifty-year resurvey of the flora and fauna of the Island was completed in 1923, the floral portion being published under the editorship of Lewis (3). In preparation for the celebration of the seventy-fifth anniversary, several visits were made to this historic site during the summer of 1947. The major findings insofar as marine algae are concerned are listed below. The findings of other botanical materials will be reported in subsequent papers.

In 1874 Jordan (1) published a list of 81 species of algae found during the operation of Agassiz' school. Shortly after the founding of the Marine Biological Laboratory and the U. S. Bureau of Fisheries station at Woods Hole, a marine biological survey of the region was undertaken. Davis (2) published the botanical results in 1913. Other publications (e. g. 3, 4, 5, 6, 7),

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largely of Taylor's work, have amplified and modified the list of algae known from Penikese. It is unfortunate that only a very small amount of the material foundation for the published records is known to be extant. Some of this material was reinvestigated (4) and some of the earlier records shown to be probably incorrect. Some of the early recorded species are not now recognized as specifically distinct; some of the specific names used earlier are currently considered to be synonyms. An effort is made here to assemble the records of Penikese Island algae, sort out the synonyms and point out which of the old records are unique.

In an effort to accomplish this end in a concise manner that will still indicate the opinions of the original authors the following treatment is given. Names that are accepted as valid for the purposes of this paper appear in small capital letters. Names which for the purposes of this paper are considered as synonyms in reference to reports of Penikese algae appear in italics. The numbers following entries in the lists below refer to the publications in the list of literature in which that species is reported from Penikese. Key citations for species not previously reported from the Northwest Atlantic by Taylor (8) and for names not previously used for species found in this area are given by similar numbers in parentheses following the authority name. The letter "A" indicates that the species was reported from the Island on good authority by one or more of the investigators visiting the Island during the summer. A "B" indicates that herbarium material was prepared and is to be found in the herbarium of the Marine Biological Laboratory or in the herbarium of the collector. The four-place numbers above 5000 identify herbarium specimens in the author's herbarium.

At least one collection of each blue-green algal species reported here has been identified by Dr. Francis Drouet of the Chicago Museum of Natural History. The determinations of Cladophoraceae have all been made or checked by Dr. Harry Phinney of Oregon State College. The determinations of many of the microscopic Rhodophyta were made by Mrs. Isabella Abbott of the University of California. Many of the more interesting observations and collections were provided by Dr. Hannah T. Croasdale of Dartmouth College. The author has had the

privilege of drawing upon the herbarium and experience of Prof. Wm. Randolph Taylor in many instances. Most of the collecting of materials was done by the following who accompanied the author on trips to the island and collected as three teams: Miss Marie Boyle, Mr. Remi J. Cadoret, Miss Elizabeth M. Fahey, Miss Amy Gage, Mr. Edwin Moul, Mr. Leonard Spiegel, Prof. Wm. Randolph Taylor, Dr. R. D. Wood, Mrs. Urda Wood—whose cooperation was greatly appreciated.

The floral, and probably the faunal, associations are delimited vertically in such a way that the intertidal area seems broken into four zones. Serially the uppermost of these zones has been named *adlittoral*, and the remaining three, in order, after Feldmann (9), *supralittoral*, *littoral*, and *infralittoral*. From a distance or from an aerial photograph these appear from the uppermost downwards as a white zone, largely bare boulders devoid of vegetation, above the normal reach of the spray; a blackish zone dominated by blue-green algae extending from the highest tide and normal spray levels down to approximate mean high tide level; a brown zone extending from approximate mean high tide level to approximate mean low tide level; a darker brown zone, including many of the Rhodophyta, extending down at least 10 meters, and probably much farther, below approximate mean low tide level. Subdivisions of these major zones may be recognized as various *horizons* correlated with various tide levels and supporting associations characteristically dominated by different algal species. At the head of each divisional list notes on the dominant members of one or more associations are given. No attempt has been made to indicate all the associations or their distribution around the Island. No major differences between the situation as reported by Lewis (3) and the current situation were noted other than the further destruction of Gull Island, perhaps due to its being used as a practice-bombing target during the war and during the survey. Accordingly, no close investigation was made of Gull Island.

SCHIZOPHYTA

No consideration was given to members of this division other than "blue-green algae." Herbarium materials of all species found by the present survey are deposited in the herbarium of the

Chicago Museum of Natural History. In general the species may be recognized as belonging in one of three categories. The first of these is of species that are restricted to peculiar habitats or particular hosts. As examples we might list *Calothrix parasitica* in the fronds of *Nemalion* and *Aegira* or *Isactis plana* on the fronds of *Punctaria*. The second category consists of the species generally distributed in and on the calcareous remains of molluscs and similar substrata. Species such as *Hyella caespitosa*,[2] *Mastigocoleus testarum*, *Lyngbya lutea* and *Plectonema terebrans* may be listed here. A third category of species consists of the algae contributing to the conspicuous "Calothrix-zone," the supralittoral zone of Feldmann (9). Because of their interest here from a physiologico-ecological viewpoint (10) particular attention was paid to this association. Here, though *Calothrix crustacea* and *Plectonema calothrichoides* are perhaps the most frequent or dominant, other species such as *Calothrix scopulorum*, *C. vivipara*, *Entophysalis granulosa*[2] and *Plectonema norvegicum* are frequent. Late in the season *Rivularia atra* became conspicuous near mean high-tide level as hard, gelatinous, black, pin-head-sized hemispheres on the barnacles and rocks. It had been present earlier as an inconspicuous occasional alga on stones near mean low water.

ANABAENA TORULOSA (Carm.) Lagerh. 3.
CALOTHRIX CONFERVICOLA (Roth) Ag. *ex* Born. & Flah. 1, 3.
CALOTHRIX CRUSTACEA Born. & Flah. 3, A, B 7018, 6956.
CALOTHRIX FUSCOVIOLACEA Crouan. 3.
CALOTHRIX PARASITICA (Chauv.) Thur. & Flah. 3, B 6958a.
CALOTHRIX SCOPULORUM Born. & Flah. 1, 3, B 6958.
CALOTHRIX VIVIPARA Born. & Flah. B.
ENTOPHYSALIS GRANULOSA Kütz. B 7018, 6957.
HYDROCOLEUM LYNGBYACEUM Gom. 22.
HYDROCOLEUM GLUTINOSUM (Ag.) Gom. 3, 22.
HYELLA CAESPITOSA Born. & Flah. 3, A, B.
ISACTIS PLANA (Harv.) Thur. *ex* Born. & Flah. 3, A, B.
LYNGBYA AESTUARII (Mert.) Liebm. 3.
LYNGBYA LUTEA Gom.? B.
MASTIGOCOLEUS TESTARUM Born. & Flah. 3, B.
OSCILLATORIA MARGARITIFERA Kütz. 3.
PHORMIDIUM PAPYRACEUM (Ag.) Gom. 3 (but see 22).
PLECTONEMA CALOTHRICHOIDES Gom. B.

[2] Forms found on shells between tide levels that otherwise could very well have been identified with *Entophysalis granulosa* have been treated as *Hyella* species.

PLECTONEMA NORVEGICUM Gom. B 6958.
PLECTONEMA TEREBRANS Gom. B.
RIVULARIA ATRA Roth *ex* Born. & Flah. 3, A, B.

CHLOROPHYTA

Prasiola stipitata often appears in characteristic fashion in the supralittoral zone (8, 11). On often sprayed rocks in the same zone elsewhere green algae are conspicuous as associations of stunted *Blidingia minima* and, with abnormally upwardly displaced *Fucus*, forms of *Ulothrix flacca*. Where there is an exposure either to fresh water or in pools where the salinity is apt to vary considerably beyond the normal range of variation, associations of *Enteromorpha intestinalis* are apt to appear. These latter three associations may, very likely, really belong with the next lower level, or at least to the same horizons as *Fucus spiralis*.

In the littoral zone little was found in the way of more or less enduring associations in which green algae were dominant forms. Often here, though, such forms as *Ulothrix flacca* are conspicuous in limited areas or, as reported by Fahey & Doty (12), *Enteromorpha* species make their appearance as relatively transitory dominants.

In coves and along open shores among boulders, and so in a way protected, *Enteromorpha linza* will often be a dominant form, usually definitely above *Ulva Lactuca*. In the most protected parts of the embayment between Tub Point and the main part of the island *Ulva Lactuca* var. *latissima* becomes conspicuous attached there to shells and stones on the sandy mud at about mean low water level. At no place was *Cladophora* (see Lewis, 3) a dominant alga.

BLIDINGIA MINIMA (Näg. in Kütz.) Kylin (24). 3, A, B.[3]

All forms found were small and unbranched (e. g. 7159, 7143, 7123).

[3] BLIDINGIA Kylin

Thalli tamquam proliferatio una vel plures e lamina in centro duarum cellularum crassa orientes, non ramosi ramosive, basibus ramorum latis factis; cellulae uno chloroplasto atque plerumque uno pyrenoideo praeditae, non ordinatae vel in ordinibus irregularibus dispositae, plerumque diametro 5–7 μ, membrana saepius fere crassitudine eadem; reproductio asexualis per zoosporas nonphototacticas, astigmaticas, quadriflagellatasque; reproductio sexualis ignota.

Type species: *Enteromorpha minima* Nägeli in Kützing. Species Algarum. 1849.

BRYOPSIS PLUMOSA (Huds.) C. Ag. 1, A, B 7136.
CHAETOMORPHA AEREA (Dillw.) Kütz. 1, A, B 7210.
CHAETOMORPHA LINUM (Müll.) Kütz. 3.
CHAETOMORPHA MELAGONIUM (Weber & Mohr) Kütz. 1, 3.
Chaetomorpha Olneyi 1 = C. AEREA (Dillw.) Kütz.
Cladophora albida 1, 3 = C. REFRACTA (Roth) Kütz.
Cladophora albida var. *refracta* 3 = C. REFRACTA (Roth) Kütz.
Cladophora arcta (Dillw.) Kütz. = SPONGOMORPHA ARCTA (Dillw.) Kütz.
CLADOPHORA EXPANSA (Mert.) Kütz. 3.
CLADOPHORA FLEXUOSA Griff. *ex* Harv. 1.
Cladophora fracta (Müll.) Kütz. 1.

This is probably *C. expansa* (Mert.) Kütz. or *C. flavescens* (Roth) Kütz.

CLADOPHORA GLAUCESCENS Griff. *ex* Harv. 1.
CLADOPHORA GRACILIS (Griff. *ex* Harv.) Kütz. 1, 4, A, B 7263.
Cladophora lanosa 1 = SPONGOMORPHA LANOSA (Roth) Kütz.
CLADOPHORA REFRACTA (Roth) Kütz. 1, 3, A, B 7127, 7150, 7131.
CODIOLUM GREGARIUM A. Braun. A.
Endoderma Wittrockii 3 = ENTOCLADIA WITTROCKII Wille.
ENTEROMORPHA CLATHRATA (Roth) Grev. 1, 3, 4, A.
ENTEROMORPHA COMPRESSA (L.) Grev. 1, 3.
Enteromorpha erecta (Lyngb.) J. Ag. = E. CLATHRATA (Roth) Grev.
Enteromorpha Hopkirkii 1 = E. CLATHRATA (Roth) Grev.
ENTEROMORPHA INTESTINALIS (L.) Link. 1, 3, A, B.

Many of the named forms were found, but of particular interest was a completely compressed linear form (7152) found in a high pool with normally inflated forms near by (*e. g.* 7144, 7142), and a very small tubular form, 7156.

ENTEROMORPHA LINZA (L.) J. Ag. 3, A, B.
ENTEROMORPHA LINZA var. OBLANCEOLATA Doty (13). A, B.

The material (7133) washed in along the southeastern shore of the island is very much like the type material both macro- and

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If one attempts to follow the International Rules of Botanical Nomenclature Kylin's name cannot be considered as anything but illegitimate (a *nomen nudum* under Article 38). Being aware both of Bliding's (Botaniska Notiser. 1938.) detailed work and apparent belief that *E. minima* represented the type for a distinct genus and of Kylin's (24) opinion, the author can do little but make these acknowledgments and follow the above procedure. He could, of course, not follow the rules in this particular case or he could, with or without pretending ignorance of these two authorities' prior opinions, propose an entirely new generic name in the prescribed manner. The same situation prevailed in the case of *Sphaerotrichia* Kylin (15).

microscopically, and distinct from all other Enteromorphoid algae found along either coast. This is the first record from the northwestern Atlantic.

Enteromorpha minima Näg. in Kütz. = BLIDINGIA MINIMA (Näg. in Kütz.) Kylin.
Enteromorpha plumosa 3 = E. CLATHRATA (Roth) Grev.
ENTEROMORPHA PROLIFERA (Müll.) J. Ag. A, B 7009, 6950, 7139, 7124, 7132.

This species is characterized by having the cells typically in rows; even when sometimes the rows are irregular the cells are angular to squarish in outline and in the middle of the membrane, which is usually ca. 12 μ thick. In surface view full-sized cells of this species usually average from 12 to 18 μ long and the rows are usually within this range in width. If proliferous the branches are attenuated basally (e. g. 7140), blunt, rounded, and usually inflated at the apex.

ENTEROMORPHA PROLIFERA var. FLEXUOSA (Wulf.) Doty (13). A, B. In South Pond where the salinity was 13.2 and the pH 9.
ENTEROMORPHA PROLIFERA var. TUBULOSA (Kütz.) Reinb. A, B.

In both South Pond (pH 9; salinity 13.2) and Tub Pond (pH 8.5–9.5; salinity 34.4) mixed with other varieties. The surface of the fronds from South Pond is papillose in cross section due to the convexity of each cell's outer membrane; this phenomenon is less pronounced in the case of specimens from more truly marine habitats. The Feldmanns (14) describe similar experimentally induced modifications of *E. marginata* J. Ag. with variation in salinity.

ENTOCLADIA WITTROCKII Wille. 3, B. On *Ectocarpus confervoides* 6949.
GOMONTIA POLYRHIZA (Lagerh.) Born. & Flah. 3, B 7300.
Hormotrichum Younganum 1 = UROSPORA PENICILLIFORMIS (Roth) Aresch.
OCHLOCHAETE LENTIFORMIS Huber (23). B 7281.

Collected for an *Ulvella* as minute patches of microscopic green crustlets on whitish granitic stones, 7281.

PLATYMONAS SUBCORDIFORMIS (Wille) Hazen. 3.
PRASIOLA STIPITATA Suhr. 3, A, B 7283, 7282.
PROTODERMA MARINUM Reinke. 3, A, B 7064.

Growing on very high rocks giving the highest algal coated rocks a brownish cast, e. g., just north of the stone pier.

Rhizoclonium Kerneri Stockm. 3.
Spongomorpha arcta (Dillw.) Kütz. 1.
Spongomorpha lanosa (Roth) Kütz. 1.

In studying the material collected the author could find no *Spongomorpha* in the collections of the different cooperators, though several specimens so labeled were turned in. All these materials were considered forms of *Cladophora refracta.*

Spongomorpha lanosa var. uncialis (Müll.) Kjellm. 3.
Tellamia contorta Batt. A, B.

In shell of *Busycon* with *Lyngbya lutea?*, 7299.

Ulothrix flacca (Dillw.) Thur. A, B.

On stunted high-growing *Fucus*, 6951; on *Polysiphonia lanosa* collected by Leonard Spiegel; on a *Busycon* shell in the mid-tide levels just north of the stone pier, and on rocks, 6951, along the north end of the island.

Ulva Lactuca L. 3, A.
Ulva Lactuca var. latissima (L.) D. C. 1, A.
Ulva latissima 1 = U. Lactuca var. latissima (L.) D. C.
Urospora penicilliformis (Roth) Aresch. 1.
Vaucheria spp. "allied to *V. murina*" 1.

PHAEOPHYTA

There are no conspicuous brown algal communities in the supralittoral reaches, but in the littoral and below they are the most frequently found dominant forms. The *Fucus spiralis* association in the upper part of the littoral zone with the *Fucus vesiculosus* association just below are perhaps the most generally occurring, with the *Ascophyllum nodosum* association extending about one foot lower than the *Fucus vesiculosus* association, and ranking a close second to the first two in prominence. *Ralfsia verrucosa* becomes dominant on the rocks, barnacles and *Littorina* in restricted localities, such as small coves, in the middle horizons of the littoral zone with or below the *Fucus* and *Ascophyllum* associations. In comparatively quiet waters *Laminaria Agardhii* may be the conspicuous alga just below low tide level

(often along with *Chorda* or *Sargassum*), while in the most exposed situations *Laminaria digitata* may be conspicuous, as around the rocks off the north end of the island. The *Laminaria* associations here as elsewhere in the world seem to be indicators of the infralittoral zone.

ACROTHRIX NOVAE-ANGLIAE Taylor. 4, 19, A, B 7138.
ASCOCYCLUS DISTROMATICUS Taylor. 5.
ASCOPHYLLUM NODOSUM (L.) LeJol. 1, 3, A, B 7188.
ASPEROCOCCUS ECHINATUS (Mert.) Grev. 1, 3.
Castagnea virescens 3 = EUDESME VIRESCENS (Carm.) J. Ag.
Castagnea Zosterae 3 = CLADOSIPHON ZOSTERAE (J. Ag.) Kylin.
CHORDA FILUM (L.) Lam. 2[4], 3, A, B 7189.
Chordaria divaricata 1 = SPHAEROTRICHIA DIVARICATA (C. Ag.) Kylin.
CHORDARIA FLAGELLIFORMIS (Müll.) C. Ag. 1, 3, A, B 7130.
CLADOSIPHON ZOSTERAE (J. Ag.) Kylin (15). 3.
DESMARESTIA ACULEATA (L.) Lam. 2, 3, A.
DESMARESTIA ACULEATA var. ATTENUATA Taylor. 5, A, B 7016.
DESMARESTIA VIRIDIS (Müll.) Lam. 1, 3, A.
DESMOTRICHUM UNDULATUM (J. Ag.) Reinke. 1, 3.
DICTYOSIPHON FOENICULACEUS (Huds.) Grev. 1, 2, 3, A, B 7016.

The author has seen none of the specimens reported as *D. hippuroides*, but feels that species is perhaps but a seasonal variety of the present species, an opinion expressed earlier by Farlow (7).

Dictyosiphon hippuroides 2 = D. FOENICULACEUS (Huds.) Grev.
ECTOCARPUS CONFERVOIDES (Roth) LeJol. 3, A, B 6949.
Ectocarpus confervoides var. *hiemalis* 3 = E. SILICULOSUS var. HIEMALIS (Crouan) Kuck.
ECTOCARPUS FASCICULATUS Griff. *ex* Harv. 3.
Ectocarpus littoralis 1 = PYLAIELLA LITORALIS (L.) Kjell.
ECTOCARPUS OVATUS Kjell. A.
ECTOCARPUS SILICULOSUS (Dillw.) Lyngb. 1, 3, A, B 7166.
ECTOCARPUS SILICULOSUS var. HIEMALIS (Crouan) Kuck. 3.
ECTOCARPUS TOMENTOSUS (Huds.) Lyngb. 3, A.
ELACHISTEA FUCICOLA (Vell.) Aresch. 1, 3, A, B 7147, 7018.
EUDESME VIRESCENS (Carm.) J. Ag. (15). 3, A, B 6959.

Awash in abundance all around the islands during early July; *e. g.* 6952 unilocular, 6959.

FUCUS EVANESCENS C. Ag. A, B.

[4] This, and some other records from Davis' paper, are accepted from the charts in part I.

Fucus nodosus 1 = Ascophyllum nodosum (L.) Le Jol.
Fucus spiralis L. A, B.
Fucus vesiculosus L. 1, 3, A, B.
Fucus vesiculosus var. spiralis Farl. A.
Ilea fascia (Müll.) Fries. 1, A.
Ilea fascia var. caespitosa (J. Ag.) S. & G. (21). 3.
Laminaria Agardhii Kjellm. 2, 3, A, B 7196.
Laminaria ascia 1 = Ilea fascia (Müll.) Fries.
Laminaria digitata (L.) Edmons. 1, 3, A, B 7191.

Collected *in situ* among offshore rocks along the north end of the island about three to five feet below mean low water line.

Laminaria longicornis 1 = Laminaria longicruris De la Pyl.
Laminaria longicruris De la Pyl. 1.
Laminaria platymeris De la Pyl. 3, 6.
Laminaria saccharina (L.) Lam. 1.
Lathesia tuberiformis 1 = Leathesia difformis (L.) Aresch.
Leathesia difformis (L.) Aresch. 1, 3, A, B.

On *Corallina* on the offshore rocks at the north end of the island, 7158.

Mesogloia divaricata 3 = Sphaerotrichia divaricata (C. Ag.) Kylin.
Myrionema balticum (Rein.) Foslie. A.
Myrionema globosum (Rein.) Foslie. A, B.
Myrionema Leclancheri (Chauv.) Harv. 3.
Myriotrichia clavaeformis Harv. 4.
Petalonia fascia 3 = Ilea fascia (Müll.) Fr.
Petalonia fascia var. *caespitosa* 3 = Ilea fascia var. caespitosa (J. Ag.) S. & G.
Punctaria latifolia Grev. 3, A.
Punctaria plantaginea (Roth) Grev. A.
Punctaria tenuissima 1 = Desmotrichum undulatum (J. Ag.) Rein.
Pylaiella litoralis (L.) Kjellm. 1, 3.
Ralfsia verrucosa (Aresch.) J. Ag. 3, A, B 7016, 7276.
Sargassum Filipendula C. Ag. 1, 2, A, B.
Sargassum Filipendula var. Montagnei (Bail.) Coll. & Herv. 1.
Sargassum Montagnei 1 = S. Filipendula var. Montagnei (Bail.) Coll. & Herv.
Sargassum vulgare 1 = S. Filipendula C. Ag.
Scytosiphon lomentaria (Lyngb.) J. Ag. 3, A, B.
Scytosiphon attenuatus Kjellm. (25) (= *Chordaria attenuata* Foslie. 1887. *Tromsø Mus. Aarshefter* 10: 175–195.) (= *Scytosiphon attenuatus* (Foslie) Doty, *Farlowia* 3: 38.)

A new record for the New England flora.

SPHACELARIA CIRRHOSA (Roth) C. Ag. 1, 3, A, B.

Also an undetermined species on *Ahnfeltia* 7169a.

SPHAEROTRICHIA DIVARICATA (C. Ag.) Kylin (15)[5]. 1, 3, A, B.

RHODOPHYTA

As was the case with the brown algae, there seem to be no associations in the supralittoral zone on Penikese that are dominated by red algae. In the littoral zone *Bangia*, often mixed with *Calothrix* or *Codiolum*, may show as a distinct dominant in the upper horizon of the littoral zone. *Polysiphonia novae-angliae* and *Ceramium rubrum*, though extending lower, are frequently dominant forms in the lower horizons of the littoral zone. Lewis (3) mentioned such forms as "noticeably absent" during the 50-year survey. *Hildenbrandia* is often a dominant form between the upper and infralittoral zone species and the *Ralfsia*, *Ascophyllum* and *Fucus* associations of the higher littoral zone. *Chondrus crispus*, extending down at least elsewhere as far as forty feet, and, in exposed places, *Corallina* form conspicuous associations from the upper infralittoral limits downwards at least three meters. On rocks and shells over sandy bottoms, as for example off Tub Point in the bay, *Dasya*, *Ceramium*, and less frequently *Champia* or other genera (usually delicate species) may be dominant Rhodophyta in the lower horizons of the superior infralittoral zone.

ACROCHAETIUM AMPHIROAE (Drew) Pap. (16). B in Herb. I. A. Abbott, 1694.

A new record for the Northwestern Atlantic collected on *Corallina officinalis* by Mr. David Erskine.

ACROCHAETIUM DAVIESII (Dillw.) Näg. 1, A.
ACROCHAETIUM THURETII (Born.) Coll. & Herv. B.

Determined as the forma *agama* of Rosenvinge on *Rhodymenia*

[5] *Sphaerotrichia* Kylin

Phaeophyceae cylindricae, divaricate ramosae; monaxiales, crescentes in longitudinem activitate meristematis apicalis cuius cellula terminalis dilatata globosaque; regio medullaris cava infra facta aut cellulis magnis parenchymatis impleta; rhizoidea solum ad basim adsunt; filamenta assimilatoria brevia, cellulis inflatissimis terminata; pili phaeophyceani meristemate basali praediti; sporangia unilocularia in cortice dispersa e partibus basalibus systematum pilorum enascentia.

Type species: *Chordaria divaricata* C. Agardh. Syn. Alg. Scand. 1817. See footnote under *Blidingia minima* (Näg. in Kütz.) Kylin.

palmata (7149) by Mrs. Abbott, and again (7261) from *Phyllophora membranifolia*, a new generic host for the species.

Acrochaetium virgatulum 3 = Chromastrum virgatulum (Harv.) Pap.
Acrochaetium Zosterae Pap. (16). B 7186.

On the tips of *Laminaria digitata;* forming irregular red flecks and minute tufts on the surface.

Actinococcus subcutaneus 3 = Phyllophora Brodiaei (Turn.) J. Ag.
Agardhiella tenera (J. Ag.) Schmitz. 2, A.
Ahnfeltia plicata (Huds.) Fries. 1, 2, 3, A, B.
Antithamnion americanum (Harv.) Farl. 1 (but see 4), A.
Antithamnion cruciatum (C. Ag.) Näg. 2, 3, 4, A, B.

Other sterile material was collected by Mrs. Abbott, 30-VII-'47, on both *Zostera* and *Chondrus*.

Antithamnion Plumula (Ellis) Thur. 1, 20.
Asparagopsis hamifera (Har.) Okam. 4, A, B.

Found in abundance in early July and in much less abundance in August (7119, cystocarpic).

Bangia fuscopurpurea (Dillw.) Lyngb. 1, A, B.

In places on *Fucus* and with *Blidingia minima* (7159) and forming slick felty coatings on high-tide rocks. This latter material (7018, sterile) was a uniseriate thick-elastic-walled form. During the month of July small forms were collected on *Chondrus* that were seen to have short rhizoids from the lowermost three to four cells only after the fashion of *B. ciliaris* Carm. as illustrated by Taylor (8).

Callithamnion americanum 1 = Antithamnion americanum (Harv.) Farl.
Callithamnion Baileyi Harv. 1, 4, A, B.

Growing in truncated stubby tufts on *Corallina* on the exposed sides of the offshore rocks at the north end of the island (7209, tetrasporic).

Callithamnion Borreri 1 = Pleonosporium Borreri (J. E. Smith) Näg.
Callithamnion byssoideum Arn. 1, A, B 7179.

One collection (7179) washed in bearing an abundance of procarps.

CALLITHAMNION CORYMBOSUM (J. E. Smith) C. Ag. 1, 3, 4, A, B.
Callithamnion Daviesii 1 = ACROCHAETIUM DAVIESII (Dillw.) Näg.
Callithamnion luxurians 1 = CHROMASTRUM VIRGATULUM (Harv.) Pap.
Callithamnion plumula 1, 20 = ANTITHAMNION PLUMULA (Ellis) Thur.
CALLITHAMNION ROSEUM (Roth) Harv. 4, A, B 7174.
Callithamnion seirospermum 1 = SEIROSPORA GRIFFITHSIANA Harv.
Callithamnion Turneri 1 = SPERMOTHAMNION TURNERI (Mert.) Aresch.
Ceramium arachnoideum 1 = C. FASTIGIATUM Harv., or C. RUBRUM (Huds.) C. Ag. (4).
CERAMIUM DIAPHANUM (Lightf.) Roth. 1 (but see 4), A, B.

The material found (*e. g.* 7160, 7182) was adrift and sterile. Lewis & Taylor (4) say all the Jordan herbarium material investigated was *C. fastigiatum* Harv.

CERAMIUM FASTIGIATUM Harv. 1, 3, 4, A, B.

Washed in all around the island (7018, 7177, tetrasporic) and on the bottom below low tide level (7180).

CERAMIUM RUBRUM (Huds.) C. Ag. 1, 2, 3, 4, A, B 7183.

Many of the ambiguous forms of this species were observed and collected; of these a particularly proliferous cystocarpic specimen (7181) and one cystocarpic covered with crustose corallines (7018), might be specifically mentioned as unusual.

CERAMIUM STRICTUM (Kütz.) Grev. & Harv. 3, A.
Ceramium tenuissimum authors = C. FASTIGIATUM Harv.
CHAMPIA PARVULA (C. Ag.) Harv. 1, 2, 3, A, B 7162.
CHONDRIA BAILEYANA (Mont.) Harv. 3, 4, A, B.

Tetrasporic (7121) just below *Fucus vesiculosus* in large hemispherical clumps.

CHONDRIA SEDIFOLIA Harv. A, B 7135, 7141.
CHONDRIA TENUISSIMA (Good. & Wood.) C. Ag. A, B 7192.
Chondria tenuissima var. *Baileyana* 3 = CHONDRIA BAILEYANA (Mont.) Harv.
Chondriopsis tenuissima authors = CHONDRIA TENUISSIMA (Good. & Wood.) C. Ag.
CHONDRUS CRISPUS (L.) Stack. 1, 2, 3, A, B.
CHOREOCOLAX POLYSIPHONIAE Reinsch. 3.

CHROMASTRUM VIRGATULUM (Harv.) Pap. (16). 1, 3.
CORALLINA OFFICINALIS L. 1, 2, 3, A, B.
Cytoclonium purpurascens 1, 3 = C. PURPUREUM (Huds.) Batt.
Cystoclonium purpurascens var. *cirrhosa* 3 = C. PURPUREUM var. CIRRHOSUM Harv.
Cystoclonium purpurascens var. *stellata* 3 = C. PURPUREUM (Huds.) Batt.
CYSTOCLONIUM PURPUREUM (Huds.) Batt. 1, 3, A, B 7011, 7190.
CYSTOCLONIUM PURPUREUM var. CIRRHOSUM Harv. *apud* Taylor (8). 2, 3, A, B 7018.
Dasya elegans 1 = D. PEDICELLATA C. Ag.
DASYA PEDICELLATA C. Ag. 1, A, B 7017, 7178.
Delesseria sinuosa 1, 2, 3 = PHYCODRYS RUBENS (Huds.) Batt.
Dumontia filiformis 6 = D. INCRASSATA (Müll.) Lam.
DUMONTIA INCRASSATA (Müll.) Lam. 6, A.
ERYTHROTRICHIA CARNEA (Dillw.) J. Ag. 6, A.
Erythrotrichia ceramicola 3 = E. CARNEA (Dillw.) J. Ag.
ERYTHROTRICHIA RHIZOIDEA Clel. B.

On *Sphacelaria* 7196a.

FOSLIELLA LEJOLISII (Rosan.) Howe. 3, A.
Furcellaria fastigiata? 1 = POLYIDES ROTUNDUS (Gmel.) Grev.
Gelidium corneum 1 = LOMENTARIA BAILEYANA (Harv.) Farl. (4).
Griffithsia Bornetiana 2 = G. GLOBULIFERA Harv.
Griffithsia corallina 1 = G. GLOBULIFERA Harv. (4).
GRIFFITHSIA GLOBULIFERA Harv. 1, 2, 4, A.
GRINNELLIA AMERICANA (C. Ag.) Harv. 1, 2, 3, A, B.
HILDENBRANDIA PROTOTYPUS Nardo. 2, 3, A, B 7277, 7013.
KYLINIA COMPACTA (Jao) Pap. (16). B.

Collected by Dr. Hannah T. Croasdale on *Ceramium strictum* (in Herb. I. A. Abbott, 1550).

LITHOPHYLLUM MACROCARPUM (Rosan.) Foslie. A, B.

In abundance on *Ascophyllum* but all material investigated closely was sterile.

LITHOPHYLLUM PUSTULATUM (Lam.) Foslie. 3.
LITHOTHAMNIUM LENORMANDI (Aresch.) Foslie? 3.
Lithothamnion polymorphum 2 = PHYMATOLITHON POLYMORPHUM (L.) Foslie.
LOMENTARIA BAILEYANA (Harv.) Farl. 1, 2, 4, A.
Lomentaria uncinata 2, 4 = L. BAILEYANA (Harv.) Farl.
Melobesia Lejolisii 3 = FOSLIELLA LEJOLISII (Rosan.) Howe.

Melobesia pustulata 3 = LITHOPHYLLUM PUSTULATUM (Lam.) Foslie.
NEMALION MULTIFIDUM (Web. et Mohr) J. Ag. 2, 3, A.
NULLIPORA POLYPHYLLAMEA? 1.
PHYCODRYS RUBENS (Huds.) Batt. 1, 2, 3, A, B.
PHYLLOPHORA BRODIAEI (Turn.) J. Ag. 1 (but see 4), 2, 3, A, B 7163.
PHYLLOPHORA MEMBRANIFOLIA (Good. et Wood.) J. Ag. 2, 3, 4, A, B 7018.
PHYMATOLITHON POLYMORPHUM (L.) Foslie. 2.
PLEONOSPORIUM BORRERI (J. E. Smith) Näg. 1.
Plumaria elegans 3 = PLUMARIA SERICEA (Harv.) Rupr.
PLUMARIA SERICEA (Harv.) Rupr. 1, 2, 3.
POLYIDES ROTUNDUS (Gmel.) Grev. 1, 2, A, B in Herb. Eliz. M. Fahey.
Polysiphonia affinis 1 = P. NOVAE-ANGLIAE Taylor.
Polysiphonia atrorubescens 4 = P. NIGRA (Huds.) Batt.
POLYSIPHONIA ELONGATA (Huds.) Harv. 1, 2, 3, A, B.
Polysiphonia fastigiata 1, 3 = P. LANOSA (L.) Tandy.
POLYSIPHONIA FIBRILLOSA Grev. 3, A, B 7018, 7185 cystocarpic.
POLYSIPHONIA FLEXICAULIS (Harv.) Coll. 3, A.
Polysiphonia formosa 1 = P. URCEOLATA (Lightf.) Grev.
POLYSIPHONIA HARVEYI Bail. 1.
POLYSIPHONIA LANOSA (L.) Tandy. 1, 3, A, B 7154.
POLYSIPHONIA NIGRA (Huds.) Batt. 4, B.
POLYSIPHONIA NIGRESCENS (Huds.) Grev. 1, 2, 3, A, B 7184.
POLYSIPHONIA NIGRESCENS var. DURKEEI Harv. 3.
POLYSIPHONIA NIGRESCENS var. FUCOIDES Harv. 3.
POLYSIPHONIA NOVAE-ANGLIAE Taylor. 1, 3, 4, A, B.
Polysiphonia Olneyi 1 = P. HARVEYI Bail.
POLYSIPHONIA SUBTILISSIMA Mont. 1.
POLYSIPHONIA URCEOLATA (Lightf.) Grev. 1, 4, A, B.

Collected by Leonard Spiegel on *Agardhiella;* while sterile, it seemed to be the variety *patens.*

Polysiphonia urceolata var. *formosa* 3 = P. URCEOLATA var. ROSEOLA (C. Ag.) J. Ag.
POLYSIPHONIA URCEOLATA var. PATENS (Dillw.) Grev. 3.
POLYSIPHONIA URCEOLATA var. ROSEOLA (C. Ag.) J. Ag. 3.
POLYSIPHONIA VARIEGATA (C. Ag.) Zan. 1, A.
Polysiphonia violacea 1, 3, 4 = P. NOVAE-ANGLIAE Taylor.
Polysiphonia violacea var. *flexicaulis* 3 = P. FLEXICAULIS (Harv.) Coll.
Porphyra laciniata 3 = P. UMBILICALIS (L.) J. Ag.
PORPHYRA UMBILICALIS (L.) J. Ag. 1, 3, A, B 7155.

With monosporangia in whitish areas scattered submargin-

ally as would be expected of the spermatangial areas of *P. leucosticta* Thur.

Porphyra vulgaris 1 C. Ag. = P. UMBILICALIS (L.) J. Ag.
Ptilota elegans 1 authors = PLUMARIA SERICEA (Harv.) Rupr.
RHODODERMIS GEORGII (Batt.) Coll. 3, A, B 7317.

Pointed out by W. R. Taylor on the leaves of *Zostera*.

RHODOMELA SUBFUSCA (Wood.) C. Ag. 1, 3.

Collected by Dr. Hannah Croasdale in wash at the south end of the island during the summer of 1946.

RHODYMENIA PALMATA (L.) Grev. 1, 3, 5, A, B.
SCINAIA FURCELLATA (Turn.) Biv. 4.
SEIROSPORA GRIFFITHSIANA Harv. 1, 3, A, B 7183, 7176.
SPERMOTHAMNION TURNERI (Mert.) Aresch. 1, 2, 3, A, B 7175.
SPYRIDIA FILAMENTOSA (Wulf.) Harv. 2, 3, A.
SPYRIDIA FILAMENTOSA var. REFRACTA Harv. 1.
TRAILLIELLA INTRICATA (J. Ag.) Batt. 4, A, B.

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II. FRESH AND BRACKISH WATER ALGAE OF PENIKESE ISLAND

Hannah Croasdale[1]

(Plate 1118)

The island of Penikese boasts only two brackish ponds and a fleeting number of freshwater ones. The former, being replenished from the sea by splash or seepage, apparently hold water throughout the summer. The others all dry up sooner or later.

South Pond. The deeper of the brackish ponds is at the southern tip of the island and is known as South Pond. It lies very near the east shore, separated from the sea only by a bar of shingle, and has practically no aquatic vegetation around it. It is approximately 200 x 70 feet. On August 3rd its salinity was 13.2, its pH 9.0, its temperature 30° C. It had a heavy scum of *Enteromorpha* and bluegreens all around the edge.

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Tub Pond. The other brackish pond lies in the southwest corner of Tub Point, and is sometimes shown on maps as two ponds, although the two were merged in 1947. It is relatively shallow and, being further from the sea and on a quieter shore, probably gets little splash. It is surrounded mainly by coarse grass. When full it is about 200 x 100 feet, but it dries down somewhat during the summer. In August its salinity was 34.4, its pH 9.0–9.5, its temperature 29° C. It had a heavy scum of *Enteromorpha* and bluegreens; there was also much guano flavoring it.

Typha Pond. This lies near the east shore, but protected by high land from the sea, across from Tub Point. It is the nearest thing to a freshwater pond on the island, but it undoubtedly dries up completely most summers. When full it is about 150 feet in diameter, and has much aquatic vegetation in and around it. On July 6th it was nearly full but by August 3rd it was nearly dry. Its salinity then was 0.8, its pH 8.0–8.5, its temperature 33° C. In July about half its surface was covered with a scum of conjugates and *Oedogonium*, and there was a fine bed of *Chara*. By August the *Chara* had disappeared, the scum was rotting, and patches of blue-greens were appearing on the newly exposed bottom.

Marsh. The area known as "The Marsh" lies at the northeast end of the island, where the neck leads off to Tub Point. When wet it covers an area of about 400 x 100 feet, but it dries up drastically during the summer: in July there was standing water over most of it, by August it was all dry except for about 4 square feet. In August the salinity was 0.6, the pH 8.5, the temperature 33° C (except for one springy spot, under a board, that was 22° C.) There was a bluegreen or flagellate film over much of the exposed bottom.

Dry Pond, "Zinn Pond", Leper Pond, Tern Pond. On the west side of the island there is a series of small kettle holes which contain water during the early part of the summer. By August they were all dry. From north to south they are known as Dry Pond, "Zinn Pond", Leper Pond and Tern Pond. There was a little water in Tern Pond in July, and it showed a pH of 7.0.

Cistern. An old cistern among the ruins of the Leper Houses, containing rusty water, supported a variety of flagellates.

Reservoirs. There are two reservoirs, on the high land at the center of the island. The deeper of these was dry in July and August and showed only encysted *Sphaerella*. The shallower one had several inches of water over a thin layer of silt, tinted green with *Scenedesmus* and *Pediastrum*. The water showed a salinity of 0.6, a pH of 9.0–9.5, and a temperature of 30° C.

As may be seen the freshwater algae of Penikese are severely handicapped by having no stable freshwater environment, such as a permanent pond or stream. This factor naturally outweighs most others, and a collection made during any one visit probably reflects the past and present state of dryness of habitats rather than any geographical isolation. The only way to acquire a fair knowledge of the freshwater algal population of the island would be to stay there throughout the season, for several seasons, and take repeated samples from the transient ponds as they fill and dry.

Diatoms: In the case of the diatoms, however, because of their durable shells, a careful study of the bottom mud of a pond, however small, dried or not, might reveal what diatoms it had harbored in previous favorable periods. Such a study was made by Paul S. Conger in 1923 and indicated what the diatom flora had been during the past. Mr. Conger has pointed out that another diatom survey, after a mere 25 years, would probably only bring the same forms to light again, and serve to confuse the issue. "The possibility of invasion of a new form or forms in these ponds which might make them different from the previous examination is so remote as to suggest nothing of significance." Consequently, on his recommendation, a diatom list is omitted here but may be obtained from the 1923 survey.

Chlorophyceae: As might be expected, collections from brackish ponds and from small freshwater ones on the verge of drying up yielded a relatively poor assortment of green algae. *Oedogonium* and *Spirogyra* in one pond formed extensive mats in July but disappeared later. The most conspicuous genus was *Scenedesmus* which was present in great abundance and variety in nearly all the samples. Desmids were naturally sparse, being represented mainly by *Closterium* and *Cosmarium*.

Xanthophyceae were inconspicuous on the whole but furnished several new and interesting forms.

MYXOPHYCEAE dominated the field by August, and though no wealth of species was noted, in most collections one or more genera of the Oscillatoriaceae formed the bulk of the algal material.

CHRYSOPHYCEAE[2] were disappointingly few in number considering the numbers usually found in salt and brackish water. It was hoped that *Chrysococcus*, frequently the most abundant inland water summer genus would be found; not one was seen. Two of the four genera are believed to be new records for this country, however: *Olisthodiscus luteus* Carter and *Prymnesium parvum* Carter[3]. The former had been previously observed at Woods Hole, and possibly in some of the Wisconsin lakes, but not identified.

CRYPTOPHYCEAE were numerous. The five species included a red *Cryptomonas*, but this is not believed to be new. Species erection has probably been too greatly extended for this genus whose members vary a great deal, and the red form from South Pond was probably only a variant of *C. erosa*, common to four other stations. *Chroomonas baltica* is probably a new U. S. record.

DINOPHYCEAE were extremely few, which was unexpected, because similar situations around Woods Hole frequently have an abundance of these. Chlorophycean flagellates were also sparse. *Dunaliella* was found in South Pond and *Haematococcus* developed in the laboratory in a few hours from a dried red crust. Two small organisms which might be *Chlamydomonas* or might be algal reproductive cells are shown.

Euglenophycean species were most numerous. None was particularly unexpected except possibly *Menoidium gracile*. One heavily ribbed form while abundant could not be satisfactorily placed: it has been doubtfully termed *Tropidoscyphus*.

The protozoan flagellates are the usual ubiquitous group, and in this case are rather fewer than might have been expected. A single one was found in some abundance which could not be identified at all and is not listed here.

[2] The paragraphs and tables concerning the flagellate groups of the Chrysophyceae, Cryptophyceae, Dinophyceae, Chlorophyceae and Euglenophyceae were provided by Dr. J. B. Lackey, Philadelphia, Pennsylvania, from his collections and observations while cooperating in the general survey of the Island on August 3, 1947.

[3] Carter, Nellie. New or interesting algae from brackish water. Arch. f. Protistenk. **70**: 1–68. 1938.

The following lists, from collections obtained during a few hours spent on the island in July, and again in August, are not to be considered as complete. Any differences from the lists obtained in 1923 probably indicate the current collecting conditions rather than the lapse of 25 years. The flagellate collections, by Dr. Lackey, were limited to August. Despite the poor conditions a total of 88 flagellated algae and protozoa were found and identified to genus, and in 74 cases to species.

Excluding flagellates, of the 37 forms recorded in 1924 about a third were re-found in 1947, and also, about half have been found during that interval on the other Elizabeth Islands. Of the present list of 107 forms, 49 have been found on the other Elizabeth Islands, an additional 18 have been reported elsewhere in Massachusetts, 29 are believed to be new to the state, and 5 new to science.

List of Freshwater Algae (Exclusive of Flagellates and Diatoms)[4]

CHLOROPHYCEAE

**Ankistrodesmus Chodati (Tann.-Fullem.) Brunnth.—Marsh
**A. convolutus Chorda, v. minutus (Näg.) Rab.—Leper, Marsh
A. flacatus (Chorda) Ralfs—Typha
*Chara Braunii Gruel. (Det. *R. D. Wood*)—Typha
*Chlorococcum humicolum (Näg.) Rab.—Soil cultures
*Closterium juncidum Ralfs—Typha
*C. juncidum, v. brevior (Ralfs) Roy—Typha
**C. lunula (Müll.) Nitsch., v. coloratum Klebs.—Typha
*C. parvulum Näg.—Marsh, Typha
*C. Ralfsii Bréb., v. hybridum Rab.—Leper
*C. strigosum Bréb.—Leper
*C. striolatum Ehr.—Typha
**C. venus Kütz., v. incurvum (Bréb.) Krieger—Typha
*Coelastrum cambricum Arch.—Marsh
**Cosmarium granatum Bréb., f. minor Skuja—Typha
*C. impressulum Elfv.—Marsh, Typha
**C. impressulum, forma—Tern, Typha
*C. polygonum (Näg.) Arch.—Marsh, Typha (with zygospore)
*C. punctulatum Bréb., v. subpunctulatum (Nordst.) Börg.—Typha
*C. reniforme (Ralfs) Arch.—Typha

[4] Species marked with one asterisk have not been reported before from Penikese. Species marked with two asterisks are believed to be new to Massachusetts.

*C. TURPINII Bréb., v. PODOLICUM Gutw.—Typha
**ENTEROMORPHA INTESTINALIS (L.) Grev., f. TENUIS Collins—Typha
GLAUCOCYSTIS NOSTOCHINEARUM Itzigs.—Marsh
**GLOEOCYSTIS AMPLA Kütz.—Typha
**GONGROSIRA FASTIGIATA (Borzi) Schmidle—Typha
*KENTROSPHAERA FACCIOLAAE Borzi—Tern
*MICROSPORA QUADRATA Hazen—"Zinn"
M. WILLEANA Läg.—"Zinn"
*M. WITTROCKI Läg.—Typha
MICROTHAMNION KUETZINGIANUM Näg.—Typha
*OEDOGONIUM CRASSIUSCULUM Wittr., v. IDIOANDROSPORUM Nor. & Wittr.—Typha
**PALMELLA MUCOSA Kütz.—Typha
*PEDIASTRUM BORYANUM (Turp.) Menegh.—Typha
*P. TETRAS (Ehr.) Ralfs—Typha
PROTOCOCCUS VIRIDIS Ag.—Typha and Soil cultures
*PROTODERMA VIRIDE Kütz.—Typha
*SCENEDESMUS ABUNDANS (Kirchn.) Chod.—Marsh, Typha
*S. ABUNDANS, V. ASYMMETRICA (Schröd.) Smith—Marsh, Reservoir, Typha
**S. ABUNDANS, V. BREVICAUDA Smith—Marsh, Typha
*S. ABUNDANS, V. LONGICAUDA Smith—Marsh
*S. ACUTIFORMIS Schröd.—Reservoir, Typha
*S. ARCUATUS Lemm., V. CAPITATUS Smith—Reservoir
*S. BIJUGA (Turp.) Läg.—Leper
S. BRAZILIENSIS Bohlin—Reservoir
*S. DIMORPHUS (Turp.) Kütz.—Leper, Typha
**S. LONGUS Meyen—Marsh, Reservoir
*S. QUADRICAUDA (Turp.) Bréb.—Leper, Marsh, Reservoir, Typha
**S. SERRATUS (Chorda) Bohlin—Reservoir
**SPIROGYRA MAJUSCULA (Kütz.) Czurda emend—Typha
*STAURASTRUM HEXACERUM (Ehr.) Wittr.—Typha
**S. MUCRONATUM Ralfs—Typha
**S. PUNCTULATUM Bréb., V. PYGMAEUM (Bréb.) W. & G. S. West—Typha
**STIGEOCLONIUM NANUM Kütz.—Typha
*TETRAËDRON MINIMUM (A. Br.) Hansg.—Typha
*TROCHISIA RETICULARIS (Reinsch) Hansg.—Typha

XANTHOPHYCEAE

**BOTRYDIOPSIS ARHIZA Borzi—Tern
*BOTRYOCOCCUS BRAUNII Kütz.—Typha
**HETEROTHRIX QUADRATA Pascher—Soil culture
MERINGOSPHAERA HENSENI Schiller, v. **brevispina, var. nov.—Tern

*Ophiocytium cochleare A. Br.—Typha
*O. majus Näg.—Marsh
O. **undulatum, sp. nov.—Marsh
Radiosphaera **Nemiahi, sp. nov.—Marsh
**Tetraedriella acuta Pascher—Typha
Tribonema Gayanum Pascher—Tern, Typha
*T. minus Hazen—Marsh, "Zinn"

MYXOPHYCEAE

Anabaena californica Borge, f. **subconstricta, fa. nov.—Typha
**A. flos-aquae (Lyngb.) Bréb., v. gracilis Klebahn—Typha
*A. inaequalis (Kütz.) Born. et Flah.—Marsh
*Chroococcus minutus (Kütz.) Näg.—Typha
*C. turgidus (Kütz.) Näg.—Marsh
**Lyngbya Allorgei Frémy—"Zinn"
*Merismopedia tenuissima Lemm.—Typha
**Nostoc rivulare Kütz.—Marsh, Typha
**Oscillatoria acutissima Kuff.—Marsh
*O. amphibia Ag.—Marsh
*O. brevis (Kütz.) Gom.—Marsh
*O. ornata Kütz.—Marsh
*O. prolifica (Grev.) Gom.—Tern
**O. pseudogeminata G. Schmid.—Soil culture
O. tenuis Ag.—Leper, Marsh, Typha, "Zinn"
*Phormidium laminosum Gom.—"Zinn"
P. tenue (Menegh.) Gom.—Marsh
Spirulina subtilissima Kütz., v. **brevis, var. nov.—Marsh
*S. tenerrima Kütz.—Typha

List of Brackish-water Algae (Exclusive of Flagellates and Diatoms)

CHLOROPHYCEAE

Enteromorpha spp.[6]

MYXOPHYCEAE

**Anabaena torulosa (Carm.) Läg., v. cylindracea (Playf.) Geitl.—South
*Aphanothece Castagnei (Bréb.) Rab.—Tub
Lyngbya aestuarii Gom. (Det. *F. Drouet*)—Tub
*L. confervoides Ag.—South
*L. epiphytica Hieron.—South, Tub
*Microcystis flos-aquae (Wittr.) Kirchn.—Tub
**M. parasitica Kütz.—Tub

[6] The species of *Enteromorpha* have been treated with the marine forms in the preceding paper by Dr. M. S. Doty.

Oscillatoria amphibia Ag.—Tub
**O. articulata Gardn.—South
**O. geminata Menegh.—Tub
O. margaritifera Kütz.—Tub
?*O. maritima C. Ag. (Det. *F. Drouet*)—Tub
*O. nigro-viridis Thwaites—Tub
*O. tenuis Ag.—South
*Spirulina maior Kütz.—Tub
*S. subsalsa Oerst.—South

List of Flagellates from Six Habitats on Penikese Island, August 3, 1947

(All in the trophic state)

	Typha	Cistern	Salt	Reservoir	Marsh	Tub
CHRYSOPHYCEAE						
Chromulina ovalis	X	X				
Ochromonas sp.			X			
Olisthodiscus luteus			X			
Prymnesium parvum			X		X	
CRYPTOPHYCEAE						
Chroomonas (setoniensis?)	X		X		X	
Chroomonas baltica	X					
Cryptomonas erosa	X	X	X		X	X
Cyathomonas truncata				X		
Rhodomonas lens						X
DINOPHYCEAE						
Amphidinium operculatum						X
Exuviaella lima						X
Glenodinium cinctum	X					
Gymnodinium palustre			X			
Gymnodinium (punctatum or simplex)			X			
Peridinium bipes			X			
CHLOROPHYCEAE						
Chlamydomonas sp. (Fig. 1)		X				
Chlamydomonas sp. (Fig. 2)		X				
Chlamydomonas sp.	X				X	
Chlamydomonas sp.					X	

	Typha	Cistern	Salt	Reservoir	Marsh	Tub
CHLOROGONIUM EUCHLORUM	X				X	
DUNALIELLA SALINA			X			
HAEMATOCOCCUS PLUVIALIS		X				
EUDORINA ELEGANS	X					
HETEROMASTIX ANGULATA			X			
LOBOMONAS ROSTRATA		X				
POLYTOMA UVELLA						X
PYRAMIDOMONAS SP			X			
THORACOMONAS PHACOTOIDES	X					
EUGLENOPHYCEAE						
ANISONEMA OVALE	X		X			
ANISONEMA SP.				X		
ASTASIA KLEBSII	X		X		X	
COLACIUM CALVUM	X					
ENTOSIPHON SULCATUS		X				
EUGLENA AGILIS	X					
EUGLENA GRACILIS	X		X			
EUGLENA FUSCA	X					
EUGLENA MUTABILIS	X					
EUGLENA PISCIFORMIS	X					
EUGLENA SPIROGYRA	X					
EUGLENA VIRIDIS	X					
EUGLENA SP.			X			
HETERONEMA ACUS					X	
LEPOCINCLIS FUSIFORMIS					X	
LEPOCINCLIS OVUM	X					
MENOIDIUM GRACILE	X		X		X	
MENOIDIUM INCURVUM	X				X	
MENOIDIUM TORTUOSUM	X				X	
NOTOSOLENUS APOCAMPTUS			X	X	X	
NOTOSOLENUS ORBICULARIS	X		X		X	
PETALOMONAS CARINATA	X				X	
PETALOMONAS MEDIOCANELLATA	X					
PERANEMA TRICHOPHORUM	X		X		X	
PHACUS BREVICAUDA					X	
PHACUS PARVULA					X	
PHACUS PLEURONECTES	X					
PHACUS PYRUM	X				X	
PHACUS TRIQUETER	X				X	
PHACUS LONGICAUDA					X	

	Typha	Cistern	Salt	Reservoir	Marsh	Tub
TRACHELOMONAS HISPIDA	X			X	X	
TRACHELOMONAS OBOVATA	X				X	
TRACHELOMONAS PUNCTATA					X	
TRACHELOMONAS RUGOSA				X		
TRACHELOMONAS VOLVOCINA	X					
TROPIDOSCYPHUS OCTOCOSTATUS			X			
TROPIDOSCYPHUS SP. (Fig. 3)			X			
PROTOZOA[7]						
ACTINOMONAS SP.			X			
BICOECA LACUSTRIS			X		X	X
BICOECA SP.			X			
BODO ANGUSTUS					X	
BODO CAUDATUS					X	
BODO LENS					X	
BODO MINIMUS						X
BODO RENIFORMIS			X			X
BODO SP.	X			X	X	
COPROMONAS SUBTILIS						X
DINOMONAS VORAX				X		
HEXAMITUS INFLATUS						X
MASTIGAMOEBA LONGIFILUM						X
MONAS AMOEBINA				X	X	
MONAS SP.			X			
MONOSIGA OVATA	X					
OICOMONAS TERMO	X			X	X	
OICOMONAS SOCIALIS				X		X
PLEUROMONAS JACULANS			X			
POTERIODENDRON PETIOLATUM	X					
RYNCHOBODO NASUTA			X			X
SALPINGOECA MINUTA			X			
TREPOMONAS AGILIS	X					X

DESCRIPTIONS OF NEW FORMS

COSMARIUM IMPRESSULUM Elfv. forma. (Pl. 1118, Figs. 5, 6). A form approaching *C. impressulum* f. *suborthogona* Racib. in shape and f. *minor* Turn. in size. Length 20–23 μ, breadth 14–18 μ, thickness 8–13 μ. Tern Pond, Typha Pond.

[7] **The few non-flagellate forms listed here are included merely as a matter of record and not through any belief that they may belong to one of the "algal series."**

RADIOSPHAERA **Nemiahi**[8], sp. nov. (Pl. 1118, Fig. 8). Cellulae ellipsoideae, membranis levibus; spinae maxima ex parte aequatoriales, attenuatae, autem, pauciores brevioresque quam in *R. sol* Pascher. Cellulae intus incognitae. Cellulae 8 x 10 μ, spinae 2–5 μ long. Marsh.

MERINGOSPHAERA HENSENI Schiller, v. **brevispina**, var. nov. (Pl. 1118, Fig. 7). Varietas spinas pauciores brevioresque, processibus consimiles, habens. Cellulae sine spinis 10–15 μ lat.; spinae 1–1.5 μ lat., 6–9 μ long. Tern Pond.

OPHIOCYTIUM **undulatum**, sp. nov. (Pl. 1118, Fig. 9). Cellula solitaria, brevis, non convoluta sed aequaliter undulata, c. 4 undulationibus; apex rotundatus, basis spinam brevem disco basali praeditam habens. Cellula 7 μ lat., 40 μ long. Specimen unicum visum. Marsh.

ANABAENA CALIFORNICA Borge, f. **subconstricta**, fa. nov. (Pl. 1118, Fig. 1, 2). Forma a typo differens sporis subconstrictis asperisque et magnitudine paulo minore; cellulae vegetativae pseudovacuolas praebentes. Veg. cell. 4–4.5 x 4–6 μ, heterocyst. cell. 6 x 10 μ, sporae 5–5.5 x 12–16 μ. Typha Pond. Geitler includes this species in *A. inaequalis* (Kütz.) Born. et Flah., disregarding its tapered end cell. My form resembles so much more closely Borge's figures and description that I prefer to maintain his species.

SPIRULINA SUBTILISSIMA Kütz., v. **brevis**, var. nov. (Pl. 1118, Fig. 3). Varietas multo brevior quam typus, extremitatibus acuminatis et spiris laxioribus. Trichomata 0.8–0.9 μ lat., 10–20 (–25) μ long., spirae 1.5–2.0 μ lat., anfractibus 3–6, inter se 3.5–4 μ distantibus. Marsh.

EXPLANATION OF PLATE 1118

ANABAENA CALIFORNICA Borge, f. **subconstricta**, fa. nov.: Fig. 1, end of filament; Fig. 2, ripe spore.
SPIRULINA SUBTILISSIMA Kütz., v. **brevis**, var. nov.: Fig. 3.
COSMARIUM IMPRESSULUM Elfv., forma: Figs. 5, 6.
MERINGOSPHAERA HENSENI Schiller, v. **brevispina**, var. nov.: Fig. 7.
RADIOSPHAERA **Nemiahi**, sp. nov.: Fig. 8.
OPHIOCYTIUM **undulatum**, sp. nov.: Fig. 9.
COSMARIUM POLYGONUM (Näg.) Arch.: Figs. 10, 11, 2 forms; Fig. 12, zygospore; Fig. 13, another zygospore at lesser magnification.
All figures except no. 13 drawn to same scale, with aid of camera lucida.

[8] Named in honor of Professor R. C. NEMIAH, of Dartmouth College, who has guided the author through hundreds of Latin diagnoses.